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SOME FACTORS IN STUDENT SCHOLARSHIP.

BY V. KARAPETOFF,

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A faculty committee on recognition of student scholarship was formed in Cornell University in 1916, and members of the faculty were asked to contribute their views and recommendations for discussion.

The following remarks were written in response to this invitation, and were subsequently edited for this article with the omission of purely local matters.

That which Cornell University has done for its own students might be well done by the Society for the Promotion of Engineering Education for all technical colleges. The first step would be the appointment of a committee to consider measures and methods of instruction that best encourage and stimulate student scholarship. A suitable name would be "Committee on Methods of Instruction."

The following remarks may give some idea of the character and scope of work of such a committee.

Standardization of Courses, without adaptation to individual needs or fancies, is detrimental to interest and initiative. By tightening the discipline more work and better work can be ground out of a student, but this is far from true scholarship inspired by genuine interest. For average or indifferent scholars standardization may be good, but in this mass of mediocrity the gifted minority is drowned. Pick out gifted scholars in the Freshman year and guide them separately as honor students. The effect will be good for them, and will stimulate the big inert body of "barely passings."

Utilitarian View on College Education, with a degree and a job as the only ends in view, is detrimental to high scholarship. One remedy is to provide several grades of degrees, or

to number diplomas each year in the order of their holders' scholarship. At West Point and at Annapolis there is a distinct advantage in having high marks. In the C.E. College in Petrograd from which I graduated one had to have at least a grade of 80 per cent. in all important subjects throughout the five years in order to get a first-degree diploma. The rest got a second degree diploma, which involved a distinct disadvantage in rank in governmental service. The Russian universities used to grant three kinds of baccalaureate degrees, according to scholarship: candidate of rights, true student and lover of enlightenment. Only the first named degree qualified for government service. At graduation exercises the name of the best scholar used to be put on a marble tablet in golden letters and placed in the hall of honor. This distinction was always coveted by several men throughout the five years of the course. I believe that two grades of degrees are perfectly feasible in this country, for example calling one degree M.E. " with honor." With the democratic tendencies of the times, when every Tom, Dick and Harry enters a university, it is necessary to keep up the scholarship of a majority by a rigid discipline, and to have a tangible goal for the capable and ambitious minority, say a different shade sheepskin. True scholars will take care of themselves, and we shall have them as long as we have faculty members who themselves are true scholars and investigators.

Ignorance of Psychology of Study.—It is a matter of common knowledge that a student wastes considerable time because he does not know how to study, and how to take care of his mind and body. The psychological process of assimilation of knowledge is one of the subtlest known, and who trains the student in it? Who tells him of introspection, of psychology of attention, of first and second fatigue, of the plateau of effort, of associative memory, of superposition of starting periods, and of such other useful things that permit one to achieve much in a short time? Many persons have said to me that they fail to see how I find time for this or that; but in the twelve years of my teaching career in this country only

one faculty member came to ask me about my methods of study. He never came a second time either, because he thought that to use my methods would be like wearing several steel braces. And yet I find my yoke easy, because I learned the systematic efficient way of living and working while I was young. Let our instructors learn how to study, and let them teach Freshmen, in application to some simple subject, how to remember a given fact or law, how to assimilate a relationship, how to acquire manual skill, how to spend an evening in study, etc. Even mathematics and mechanics can wait half a year for such an important discipline, one that will save each student many a weary hour throughout his life. This is one reason why each instructor should be a student of some subject, and an investigator. He will know then what the process of assimilation is, and what miracles can be achieved once an intense interest has been aroused in the student.

Physical, Volitional and Emotional Activities.—A normal young man needs all these, but most colleges do not properly regulate them, except perhaps for military drill and athletics. Self-supporting students who wait on table or tend furnaces get physically exhausted, while rich fraternity boys ride in a street car a distance of a few blocks. Who can overestimate the importance of a properly trained will in a college graduate? Is it more important for the country that he should know how to determine the size of a shaft or of a steam cylinder, or that he should stay on the straight path in the hour of temptation, and be able to guide others? There is no study more difficult than the training of the will, but when the will is under control all other studies are open to the man.

Co-operative Study.—It has been well said: "School is not preparation for life, it is life itself." We do not care to make it an imperfect life of laziness and cruelty, of greed and deceit, but let us give our students at least a glimpse of a better life of which we dream and which we hope for. Every commun-

ity is organized for some purpose; why not organize a community for the purpose of study? Then the students working to maintain and to improve this community will get the necessary volitional and emotional training. As long as they remain individual "visitors" to the college, members of an audience, they do not exercise the most important function of the civilized man, the ability to work in a community. Every difficult problem in mechanics or in electricity should be a community problem for the class, and not an individual problem for Mr. Jones. Only then will scholastic achievement be held in high esteem, and a lazy student will be ostracised as a useless member of the community. This will also give a splendid training for leaders of different kinds, mental, volitional and emotional. But of course, as long as we have to "cover" a certain number of pages in a certain book, we cannot stop to discuss an interesting problem when a previously mimeographed schedule calls for the next chapter.

Outside Work.—A considerable number of students do outside work, either to earn their living or as a voluntary avocation. Personal interviews elicit a surprising variety of such occupations, most of which are detrimental to true scholarship. The university is almost powerless to provide for impecunious students, unless it takes a radical step, and requires more fortunate students to contribute their work for the support of less fortunate one. For example, a student usually has to put in four hours a day seven days a week waiting on table for his board; this is usually to the detriment of his studies. Two other students receive all their sustenance from home, and waste some of their leisure time. Now suppose the university should encourage or even require each of these two students to wait on table for one meal a day, and thus enable their struggling comrade to have his three meals though waiting on table for one meal only. The university should take a lead in this "help your brother" movement, and I feel confident that a great deal of moral good could be accomplished both for those helping and those helped.

From Practice to Theory.—A number of freshmen and sophomores get discouraged or are dropped on account of mathematics, physics and mechanics; others manage to squeeze through, but retain no love for these subjects, and acquire no ability whatever in using them. The order of courses should be reversed, concrete facts as used in engineering practice should be taught first and then generalized into semi-abstract statements. Of course, this would mean a radical change in the arrangement and character of studies, but it would stimulate interest early in the course, and will help to weed out men without engineering talent, rather than those who are too immature for calculus. Moreover, a reasonable time should be allowed in the freshman year for descriptive and experimental lectures in various branches of engineering (orientation courses) so that the student could select the one for which he is best fit. Maladjustment is undoubtedly a serious cause of poor scholarship.*

The Faculty.—How much blame for poor scholarship among the students is due the faculty, and especially to young instructors? A mature experienced teacher and investigator presents a topic from several points of view, at least one of which should appeal to the student. He modifies his statements to suit the class, he alludes to further developments and applications of the topic under discussion, brings in parallels and analogies, and inspires the students with the mastery of his subject. A young instructor usually knows little beyond the text book, holds recitations on the same topic, sometimes a dozen times a week in sections, requires precise knowledge of certain statements and problems in the book, and mostly fails to inspire or even to interest his students. A considerable proportion of young instructors give the course for the first time, and really do not know many essential points until they get to them. These "non-commissioned" officers of instruction are a great problem in a large college,

* For further details of this so-called *concentric* method of education see the author's paper in the PROCEEDINGS of this Society, Vol. 16 (1908), p. 258.

and it is time to ask ourselves in all earnestness if we have not gone too far in breaking up courses into recitations, and converting our mature teachers into office managers? Should we not go back, at least in part, to lectures given by mature professors in larger groups, with frequent written examinations, the papers to be corrected by younger instructors?

Small Improvements and Radical Changes.—Some improvement in scholarship can be achieved by numerous small changes, such as stricter discipline, better books and schedules, higher grade teachers, prizes, etc. All these things ought to be done as opportunities present themselves. On the other hand, a few radical changes, such as are indicated above, should also be seriously considered. They may seem at first impractical, but they are based upon sound human psychology, and as such ought to refresh the atmosphere and bring into play forces within students that are at present dormant. Every reform at a certain stage is considered impractical—the democratic form of government, the freedom of religion, the abolition of monarchical government, of nobility and of servitude, all these were held to be visionary, and yet they are among the most precious and most practical achievements of civilization.

A STUDY IN CURRICULA.

BY STEWART L. MacDONALD,

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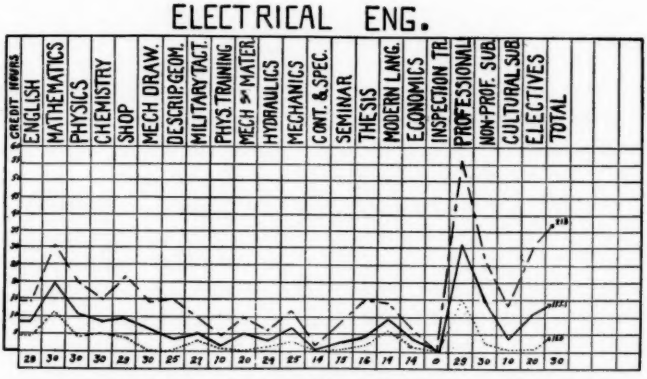
Some months ago at the Colorado Agricultural College a committee of the faculty undertook a study of the curriculum of that institution in view of making such changes as might seem advisable. One phase of the work of the committee comprised a survey of the courses of study of other similar institutions. Correspondence with more than forty of these institutions was carried on and a study made of their most recent catalogues.

The accompanying chart, which is an attempt at analysis of the courses in electrical engineering, is only one of several such charts which were worked out. While the chart, it is believed, is self-explanatory, yet some explanation may be helpful. For example, the first item on the left is that of English. The number twenty-eight (28) at the bottom indicates that out of a total of thirty institutions investigated, twenty-eight (28) were teaching English and that the maximum credit hours given this subject in any of the twenty-eight (28) institutions, as indicated by the upper dotted line, is fourteen (14); the minimum as indicated by the lower dotted line is four (4), while the average for the twenty-eight (28) is eight (8).

The unit used by the committee is the so-called credit hour. This unit is the one most commonly used by the institutions studied. A credit hour for a student may be defined to be one hour of recitation per week throughout one semester, which recitation requires on the average from one and one half to two and one half hours of outside preparation. For instance if a subject is scheduled for five recitation hours per week for one semester, and requires outside preparation as above stated, five credit

hours will be the measure of credit in this subject. The committee went on the assumption that two laboratory hours, where outside preparation is required, is the equivalent of one hour of recitation, and where no outside preparation is required, three hours of laboratory shall be reckoned as an equivalent of one recitation.

Anyone who is at all conversant with the situation will fully realize the enormity of the task of working out this chart, simply for the reason that there is so little uniformity of pro-



ELECTRICAL ENGINEERING.

—Average of thirty institutions, twenty-eight of which are land-grant colleges. —.— Highest number of credit hours offered in any of the thirty institutions. .....Lowest number of credits offered in any institution offering the course. Numerals at bottom give number of institutions offering course.

cedure in this regard even among institutions of the same class. The problem is still further complicated by the woeful lack of a uniform technique. Each of a dozen institutions will be teaching what is essentially the same subject, probably using the same text-book, each under a different name. While it is

not the primary purpose of this article to argue in favor of uniformity and standardization, yet the present situation in this regard is almost prohibitive of any intelligent comparison of the curricula of American institutions of learning.

It will be understood that under *professional* is grouped a large variety of subjects which bear directly upon the subject of electrical engineering and too numerous to tabulate individually. The distinction between the purely cultural and non-professional subjects seems justifiable on the grounds that such subjects as surveying, while not regarded as cultural, are non-professional to the electrical engineer, while such a subject as literature would be purely cultural.

ELECTRICAL ENGINEERING IN AGRICULTURAL COLLEGES.

BY A. C. STEVENS,

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Within the last decade the science of agriculture has taken the place of old-time farming and our agricultural colleges have experienced the growth which not so long ago placed the engineering schools in the forefront of educational institutions. With the war has come the scarcity of labor and farmers everywhere are being forced to pay almost prohibitive prices for what little help is available. This is accelerating the natural increase in the use of labor-saving devices, with the result that the work of the rural engineering departments in our colleges is being accorded the appreciation which in many cases had been withheld.

Those who have followed this trend in agricultural progress a little farther have noticed that electricity is playing an increasingly important part in this development. This is true in spite of the fact that electrical education is not on a par with that of other branches of rural engineering.

In too many agricultural schools the student's knowledge of electricity begins and ends with a course in physics in which Ohm's law means a dry cell, resistance box and a galvanometer. The practical application is later restricted to the use of dry cells for ignition purposes.*

* A study of catalogues of forty or fifty agricultural colleges in the country shows that in no case is a special course in electricity required. Some colleges give courses in rural engineering or farm mechanics in which electrical applications may have a small part, while others depend upon laboratory physics for the final work in practical electricity. Most colleges allow certain credit for elective work but the writer's experience at Cornell has been that a negligible percentage of the students elect work in electrical engineering. This may be due to the fact that the

Two incidents in the writer's experience come to mind which illustrate the lack of fundamental appreciation of electrical laws by college students who have had nothing but a course in physics to help them. In one case a junior, home for vacation, attempted to fix the door-bell which had been out of order for some time and after a search there were revealed two Leclanché cells in the darkest corner of the cellar. These were brought out, the solution renewed and the batteries returned, yet the bell would not ring. It took an electrician from one of the local hardware stores to explain that the wires had not been reconnected to the cells.

In the other case, a student had been given the task of changing the wiring in one of the college laboratories and after completing it decided that the ends of the two wires of the branch circuits did not look well so he carefully spliced and taped them. The lead wires were long and the regulation of the circuit poor so the fuses did not blow when the main switch was closed. It is not hard, however, to imagine the chagrin of the student on finding his wires gradually sagging, then turning dark and finally giving off volumes of dense black smoke.

While these may not be typical of the acts of college men when in search of electrical experiences, yet they indicate that electrical training does not always give the student the power to visualize the electrical action, or as some one recently expressed it, "The simple electrical laws are not a part of themselves." This condition is perhaps natural since the actual physical and visual contact which makes men so familiar with

need of the subject is not emphasized by the faculty and that the elective work given under other departments is not correlated with the prescribed agricultural course.

It is often difficult to decide from catalogues what is really covered in a certain course—so little information is given. Even the general heading may be misleading, as for instance, when courses 1*a* and 1*b* in mechanical engineering are found to be freehand drawing and carpentering respectively.

mechanical transformations of power are lacking in the case of the study of electricity.

To fit the potential farmer for intelligent use of electrical apparatus it is necessary for him to be able to handle power circuits. The experience of closing a switch on a complicated wiring job, without blowing a fuse, is one which is most helpful in instilling confidence as to one's ability to connect up and operate the ordinary electrical machinery.

Under these circumstances—with the electrical age in agriculture already at hand—it is essential that plenty of time be given to electrical study in agricultural schools. Without doubt the course for agricultural students should differ materially from that designed for engineers and would be based upon previous training, but above all it should leave a man with the feeling that he has made certain fundamental electrical principles part of his mental equipment and that he can intelligently decide such questions as he may meet concerning electrical apparatus.

No intention is here entertained of outlining such a course, yet some of the questions confronting the farmer which emphasize the importance of this training will be touched upon. In connection with an electrical exhibit recently held at Cornell during Farmer's Week, the writer had an opportunity to meet farmers from all over the state and learn something of their electrical problems. What impressed him most was, possibly, the lack of ability to ask pertinent questions about electric machinery. This is not surprising, yet the fact has an important bearing, for it means that the average farmer may be at the mercy of any electrical salesman who can talk convincingly about his goods. Even truths may be so clothed as to conceal facts as well as to reveal them.

The question as to which was the best of several small lighting plants on exhibition was the one most often asked. One was a 32-volt storage battery outfit with unit power plant consisting of a gasolene engine direct connected to the generator, another was a similar outfit with belt driven generator, while

a third consisted of a small rotary slide valve gasolene engine, direct connected to a 110-volt generator. This last set was for use without storage battery, the engine being designed to run continuously when current was desired.

It is easy to smile at the question and to quote to oneself, "Fools rush in where angels fear to tread," yet the illustration brings out the point clearly. To answer the question by saying that they are all good does not satisfy the questioner. He wishes answers to many questions which he knows not how to ask. To give these answers one must know to what use the electricity is to be put—whether for lighting alone or for some power work—what the maximum demand for current will be, how far the current will have to be carried, whether or not battery charging can be done with an engine already owned and at the same time that power is demanded for other things.

Even with these things determined, the patient questioner may still not be given as definite an answer as he desires. A recommendation in favor of one outfit may be construed as due to inherent superiority rather than to the fact that it was representative of a type most nearly suited to a special need.

So many agricultural colleges receive support from the state through political bodies that great care and diplomacy must be used not to appear to favor any one company or manufacturer. The result too often follows that the farmer who wishes to know how best to invest his money in a lighting-plant is still undecided or discouraged and gladly accepts definite statements such as the first glib salesman makes. This all goes to show that something is needed to give the farmer the very elementary grasp of electrical principles that will enable him to use his own good judgment in such matters. Decision can not be made for him for obvious reasons, so he must be trained by the colleges either in regular undergraduate courses or through extension work carried on under the direction of the universities.

The importance of agriculture to America and to the world is too well appreciated to need argument. With farms in the

United States numbering about six and three quarters millions and having a value of seventy-five billions of dollars, no effort and expense is too great to help increase the acreage under cultivation or to increase the productiveness of land already cultivated. This will be brought about by labor-saving devices of all kinds—not by cheaper farm labor—and electricity must be the open sesame for much, not to say most, of this in the future.

For the benefit of those who are interested in following the recent electrical development a short list is added of articles on the subject to be found in the technical press.

Application of Electric Motors to Farm and Dairy Industry. *G. E. Review,* 1911, p. 12.

Electricity on the Farm. A. I. E. E. Pro., July, 1912.

Electricity in Agriculture. *G. E. Review,* 1915, p. 483.

Application of Electricity to Agricultural Purposes. *London Electrician,* June 23, 1916.

Electricity in Rural Communities. *Electrical Review,* March 4, 1916.

Installation of Farm Lighting Plants. *Electrical Review and Western Electrician,* December 2, 1916.

ON THE ENGINEERING CURRICULUM.

BY A. J. BECKER,

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The numerous articles on engineering education that have appeared within the past few years show that there is a doubt concerning the effectiveness of the average engineering curriculum. The rapid progress of industry during the past decade has brought about much of this uncertainty, for the engineer today has before him a much broader and more intricate field than his fellow of fifteen years ago had. Has his preparation kept pace with the things that are expected of him? To what extent is it desirable that his preparation shall keep pace with them?

There can be but one answer to the second question, for in it are involved the reasons for the existence of the engineering colleges. Only in so far as the student is taught engineering principles and the results of engineering experience better and in less time than he could acquire them in practical work is an engineering college justified. In any professional training, it is the intention to give only the work that is most directly applicable to the practice of the profession and at the same time is fundamental or closely related to all its branches. The standard of measurement is relative values, unless there is some other criterion than utility. It has been urged that the cultural value of a course is sufficient to give it a place in the curriculum, but, while culture and the satisfaction of extra attainment should be prized, the real criterion is the fitting of the courses into a broad foundation upon which the engineering graduate must rear his superstructure. That which best fits him for his work,—not merely for the first few years, but for the later years as well—does not give him perverted ideas of his own ability, nor require too much

adaptation on his part, should make up the curriculum. This is in great measure the justification of the large amount of prescribed work.

Engineering education is largely conservative, sometimes too much so, and the danger is that we cannot bring ourselves to discard a course that has been established for years. No matter how desirable or valuable a subject may be, the decision to keep it in the curriculum or to discard it, must depend upon the number of courses that can be given and upon the relative value of each. If we could but apply our tests rationally and then unhesitatingly, even though with regret, carry out the conclusions, we should have little difficulty in keeping pace with engineering requirements. To avoid personal bias, the engineer in practical work should be freely consulted. He is the employer of the graduate and knows the things which are of greatest value. New ideas are suggested frequently and we should be ever ready to make use of those that are worthy, either in whole or by adaptation, even though the introduction may cause the dropping of courses which we have hitherto considered necessary.

As the usefulness of the engineer broadens, we are met with an increasing insistance upon more fundamental preparation, courses that tend toward a greater unity, with emphasis upon the sciences, mechanics, economics, and above all the ability to think clearly and to *apply* principles. That is, a true engineering education rather than a collection of facts, which while they are accepted practice today may be antiquated tomorrow.

There are three things that attract attention when one studies the averaging engineering curriculum. These are modern or foreign languages, shopwork and specialized instruction in narrow fields. The present critical study of engineering education as evidenced by the studies of Dr. Mann and by his recent appointment by President MacLauren of Massachusetts Institute of Technology as chairman of a permanent committee on the engineering curriculum, give weight

to the opinion that we are facing a situation in many ways similar to that faced by the Colleges of Liberal Arts when Greek and Latin were dropped as requirements for the B.A. degree. We are confronting new conditions which demand better and broader preparation; we are manifestly unwilling to adopt generally the five or six year course, so that the courses which have the least direct bearing and usefulness must yield their places, however hallowed by age and universal sanction, unless by rebuilding they can be made of far greater service.

Language study, modern or ancient, is an heirloom of the first engineering curriculum. Accepted then for reasons which do not hold now, it can show but little basis for retention. There is no intention here to discuss the cultural or disciplinary value of language study, but rather to pass these by as insufficient reasons for retention. Until we are prepared to discuss a course extending over more than four years, cultural studies must be left to the spare hours after graduation. As for the disciplinary value, any course whose principal claim to a place in the curriculum is disciplinary value, should be dropped at once and put in the list of preparatory studies. Inasmuch as language study requires considerable memory work, the sooner it is begun the better. If a modern language is needed to pursue the study of certain subjects, it should be required for admission as are algebra or English. This puts it in the high schools or even in the grades, where it properly belongs.

There are but few reasons that may be advanced in favor of the study of the languages. Briefly they are (1) that it improves the student's English, both through the closer analysis of grammar and through a better command of words derived from the other languages; (2) that it will save an engineer the humiliation of having to grovel before a foreign word or phrase when reading a paper or listening to one; (3) that the broader commercial relations between this country and the rest of the world demand ability to speak and write

other languages and through the languages to obtain a sympathetic point of view and better understanding of the peoples with whom one is dealing.

The first two points (and nearly all the others that are urged in favor of language study in an engineering curriculum) will be met as well by an entrance requirement as by time spent during the undergraduate years. Furthermore, it would seem that the acknowledged need for better English can be met more efficiently by a study of English itself, rather than other languages. The latter logically demands at least the study of French and German, if not Latin and Greek, with a preference for the Latin and Greek. With reference to the third point, those who expect to take up foreign trade work or to work in foreign lands, are the exceptions, not the rule. Language study sufficient for such purposes requires longer time than one or two years and is therefore to be considered only in so far as it may be cared for by electives or extra work. The value of language study is undoubtedly real, but when compared with English, chemistry, geology, physics, or mechanics, surely no one can feel that it should displace any of these even in small part.

One manifestation of the opinion of men in the practice of engineering is given in the compilation of the replies to the questionnaire sent out to the members of the honorary society of Tau Beta Pi by Professor Higbie, its president. In the summary* of the replies to the question "If it be impossible, in the time available, to give all things that seem desirable, which in your opinion, can be sacrificed with least injury to the student?" we find the following:

"The order in which studies should be sacrificed for lack of time, seems to be about as follows: Foreign languages, shop work, special engineering subjects. . . . The belief seems practically unanimous that foreign languages should be the first to go by the board."

Again we read, "The judgment of a large majority of these

* See also BULL. S. P. E. E., April 17, 1917, p. 498.

(the alumni) is that the study of foreign languages should not be required in colleges of engineering—certainly not in a four year training wherein even the essentials of engineering science must be treated too briefly. . . . It is quite generally conceded by those who advocate language study in the engineering college, that knowledge of foreign language is not ordinarily necessary for progress in engineering profession or in business,—in fact, that such knowledge is so infrequently called for that it is quite likely to be forgotten or to become virtually useless, unless practiced from some other motive than necessity."

The case of shopwork is rather different. There is no thought of entirely omitting it from the curriculum but to sort out the best in the subject and give this more effectively. Practically all of us will agree that the old manual training idea in shopwork is dead or should be, that there is no place in the curriculum for the development of skilled mechanics. This is the work of the trade school. But the problems of shop management, duplicate manufacture and quantity production, routing, labor problems, what to expect of an operative, piece work and other things directly connected with machine operation, require attention. The contact with the men in the shops, or the field or the mine, can best be obtained by requiring all students to put in two vacations, preferably those preceding and following the junior year—in actual work which is approved by the dean of the college, who can be of great assistance in providing this work. This is an adaptation of the cooperative idea followed at the University of Cincinnati, similar to that in use at the University of Pittsburg. It has been the experience of many of us that students who have been out of college for some time come back with a more definite purpose and study with far greater effect than during their previous attendance. Something of the same effect would be observed if students spent their vacations in apprenticeship along the lines in which they are specifically interested. The time might even be extended to require

one year to be spent in practical work before the senior year is begun. This may reduce the number of graduates slightly, but it would improve the interest in and efficiency of the work tremendously.

Some of the things ordinarily included as parts of shopwork should be given as parts of other courses. The remainder can be given in much less time than is now required, with less work in the actual manipulation of machines and more in lectures and recitations. Civil and chemical engineers accordingly should have no shopwork, mining engineers perhaps one semester in the treatment of metals, electrical engineers perhaps two semesters and mechanical engineers three semesters of two hours each, or, with the usual laboratory equivalent, one afternoon per week. This work need not all be given in the first two years, much of the time now given to shopwork could be employed to better advantage, especially if the contact with labor and the processes of industry are secured by requiring the student to take his place as one of the workers and get his knowledge by experience.

To avoid any possible misunderstanding, a definition of specialized engineering courses will be given before attempting any discussion. Such courses are those which belong to narrow fields, not those which are fundamental to either of the broad general divisions of engineering but which are possibly out of place in others. Thermodynamics or ore treatment are by no means specialized courses. In many institutions men are specialists in a particular field and feel called upon to offer courses in these specialties. The work of the students in these courses must be superficial, for they lack the experience necessary to understand the subject properly. Heating and ventilating, design of cantilever and suspension bridges, design of high office buildings, power plants for special purposes, design of air compressors, refrigerating machinery, certain forms of electrical machinery, compound engines, and turbines are illustrations of these specialized courses. Such courses as machine design, thermodynamics,

or mechanics should cover the required fundamental principles. These are all it is advisable to teach, for the applications involve much study and experience, which can only be acquired after graduation.

Few students come to college with a definite idea of the work before them or of what they want to do. They follow the courses more or less mechanically and at the end select positions largely because of the salary paid, with little reference to the future. In most instances anything beyond the broadest fundamentals will be utterly forgotten by the time there is occasion to use it, if perchance the occasion ever arises. Furthermore practice changes so rapidly that with rare exceptions the student cannot apply his special knowledge without revising it. We must remember that we should look years into the future, for we are preparing the engineers of ten or fifteen years hence, and who will be so bold as to say what engineering practice will be then? We are prone to lose sight of the fact that the four years spent in an engineering school are but the beginning of the student's preparation. We call our graduation commencement, and so it is; that which has preceded is but the clearing of the ground and the laying of the foundation. We speak lightly of foundations and fundamentals, fume over the preparation of the students who come to us, and immediately proceed to rear a topheavy superstructure. Let us, therefore, trim our dead wood and offshoots, eliminate the study of foreign languages, require them for entrance if need be, reduce shopwork and alter it where necessary, eliminate all forms of specialized courses, except for graduate instruction and then only after the student has had several years of practical experience. In the place of these courses put more English, with a greater stress upon the use of English through all the four years, and more work in fundamental sciences, chemistry, physics, geology, biology, mechanics. Such a curriculum may not be ideal, but it is worthy of thought and frank discussion.

THE WISCONSIN COURSE IN THE COMPOSITION OF TECHNICAL PAPERS.

BY HOMER A. WATT,

Department of English, New York University

(Formerly of the English Department at Wisconsin).

Instruction in English composition for engineering students has taken two directions, first, that of a course in general composition similar in most respects to the liberal arts courses in the subject, and, second, a more specific course in the composition of technical papers. The first aims to liberalize the student by giving him a broad intellectual training and by stimulating his intellectual curiosity; its purpose is to make him a better engineer by making him a trained thinker on subjects not immediately connected with his profession.* The second aims more specifically to give the student training in the composition of such technical papers as his profession is likely to demand of him; its purpose is to make him a more articulate *engineer*. The two courses are not antithetical since very much of the value of one course is naturally contained in the other. Moreover, the course in technical writing cannot be called narrow and overspecific inasmuch as the elements composing it remain constant, and the training which it gives the student is of permanent value regardless of any advance in engineering science.

At the University of Wisconsin all engineering students are required to take the course in freshman English; this consists of one semester of drill in whole compositions, para-

* The aims of a course of the first type are outlined in an article by the present writer entitled "The English Department and the Professional Schools," in the BULLETIN of the S. P. E. E. for October, 1916, and are embodied in a collection of essays edited by Professor Frank Aydelotte ("English and Engineering," McGraw-Hill Book Company, 1917).

graphs, and sentences, and one semester of analysis and study of expositions of broad, general interest. Having completed the course in freshman English, the engineering student may elect the course in advanced composition given in the College of Letters and Science or a special course in the composition of technical papers, or both courses if his program permits. Nearly all engineering students who take advanced composition, elect, however, only the technical course especially designed for them. This course has been given for six years to large classes of students from all departments of the College of Engineering. It may justly be said, therefore, to have fairly established itself; and the hope that some of the methods employed may be of interest to other teachers giving similar courses has led me, now severing my connection with the work, to describe briefly the course as it was developed during the six years when it was under my direction.

Two general aims which were kept uppermost in the course should be stated before any specific methods are described. The first aim was to preserve the individuality of the student, to keep him from becoming a "rubber stamp man"; the second was to make him independent of instructor and text-book. "Every engineering student," said one of their instructors the other day, "is seeking for a universal formula which will solve all his engineering troubles." This fact was very neatly illustrated by the experience of another engineering instructor, who recently asked his class of seniors to write letters of application. Almost without exception the letters were of the same cut—formal, frigid, dull, and absolutely conventional. Upon inquiry the instructor discovered that almost all his students had modeled their letters after one printed in a well-known text-book on commercial correspondence, copied them even to the extent of writing in every case, "I feel fully qualified to fill the position." The model was good enough as a model, but it was, of course, absolutely lacking in individuality. In the course in technical writing the students were constantly reminded that every article which they are called upon to write presents to a certain

extent a new problem, which has to be studied independently, with full consideration of the reader in the case and of the particular material being dealt with. General principles of clearness and vigor deduced from the analysis of obviously good pieces of exposition were to be used, the students were told, as general guides only. The gain from the course was to come, not from any empty and formal acquaintance with rhetorical principles, but from the power resulting from the actual grappling with and solving of problems in the clear and effective presentation of given sets of concrete or abstract facts or ideas.

The second aim referred to, that of making the student independent, is really a corollary of the first. One of the serious errors in modern university instruction is the tendency to coddle the student, to do too much for him and not to let him do enough for himself. This is the line of least resistance not only for the student but also for the instructor, since it is usually much easier to do a thing for the student than to lead him to do it for himself. And yet our task as teachers is not to make our students, but with all the patience in the world to help them to make themselves. It is always better to insist upon independent work, and not to give the student direct suggestions in connection with his writing where more good will result from his making an independent discovery.

The work done in the Wisconsin course took three directions: class work, themes, and conferences. The students received three credits for the course; for this they spent two hours a week in class, and had one weekly conference, which was substantially a private lesson of from fifteen minutes to half an hour.

The class work consisted in part of informal talks (not *lectures*) on the principles of technical writing. These were liberally illustrated by specimen expositions of the types studied, which were analyzed by the students and discussed freely in class. Expositions were taken from various sources, from books of printed selections, technical magazines, engineer-

ing textbooks and pamphlets, and mimeographed material supplied by the instructor. Occasionally students were asked to bring to class copies of the technical journals for which they subscribed and to read from these articles of general interest which they regarded as structurally good or bad. They were then asked to point out the good or bad qualities of the articles read and to make suggestions, in the second instance, for improvement. These talks and discussions formed the core of the class work. Variety was introduced, however, by drill in reconstructing bad sentences from themes and engineering magazines, by a critical examination of government pamphlets on technical subjects, published reports, advertising and publicity pamphlets, contracts, and specifications, of all of which material an abundant supply was kept on file, and by an annual lecture on the use of the engineering library generously given by the librarian. Two weeks in May were devoted to a critical study of student and other reports, and two weeks more to a study of business letters of the types usually written by engineers. All this class work was conducted as informally as possible. Students were expected to join freely in the discussions, and were invited to contribute to the files of specimen expositions printed articles which seemed to them to be worth analyzing.

The themes fell into three divisions: first, a series of five hundred word papers, one each week; following these a long paper of two thousand words or more due near the end of the semester; and finally a series of reports and letters written during the last four weeks of the course. Each short theme was supposed to be an example of the type of exposition then under discussion in class; for example, when descriptive-exposition was being studied, the students would submit technical descriptions of simple machines or of pieces of laboratory apparatus, or would explain the arrangement of a power plant or heating station which they had recently visited. The themes were not highly technical. Most of the students had had previous to their entering the course only the general courses of the first year or two in the engineering college.

Moreover, the theme work was based largely upon the propositions that by no means all writing done by an engineer is addressed to engineers, and that the engineer who can make himself understood by a layman will have no trouble in being sufficiently technical when occasion demands. Students drew their material for the themes, for the most part, from what came to hand in their laboratory and field work; they were encouraged, moreover, to submit accounts, when they had any to submit, and they quite often did, of pieces of apparatus and methods of their own devising. All of these short themes were carefully corrected by the instructor, at least fifteen minutes being spent on each one, and returned to the students. Then, after they had formed the basis of the week's conference, they were corrected or rewritten by the students and returned to the instructor, often so changed that little of the original remained.

The writing of the long theme I believe to have been one of the most valuable parts of the entire course. The work was begun early in the semester, when a class hour was devoted to a talk on the science of constructing papers of considerable length, and a conference held with each student to assist him to select an appropriate subject, and was continued throughout the semester, until, after a preliminary outline and sample introductory section had been written and duly approved, the finished paper was finally submitted. For all but the seniors in the course the long theme amounted substantially to a junior thesis, in so far, at least, as the problem of constructing the composition was concerned. The choice of the subject was one of the most important parts of the work. It was insisted that the student possess a genuine interest in what he was to write about. One of the serious mistakes in composition teaching comes, I believe, from the assumption that a student can produce a really vital or even readable piece of writing on a subject in which he has not the slightest interest. What man in active life would send to any magazine, professional or popular, an exposition which was not the expression of a real interest? And is it not

almost insulting to a student to ask him to spend hours of his college life—short and precious as it is—upon a subject which he cares nothing about, even though his efforts may give him a certain amount of expository drill? If he ever had any interest in composition, there is no more certain way of killing it. Excepting, then, in the case of a very few apathetic students, every theme subject represented a real student choice, and some of the papers were even, within narrow limits, just as genuine contributions as many more pretentious ones. Sometimes the long theme was a trip report involving a description of a power plant, fully illustrated with photographs taken by the author; sometimes it was a civil engineering student's plan for municipal improvements in his home town; sometimes it was a chemical engineering student's conception of how some chemical process might be put to a new use. Or, from students interested in the commercial and economic side of engineering would come an account of the workmen's opinion, from first-hand evidence, of an efficiency system, or suggestions for an improvement in the arrangement or management of some shop in which the writer had worked, or the story of the failure of a colonizing scheme in which the author had once participated, or perhaps a sales or publicity pamphlet explaining the construction and insinuating the merits of some machine. The solidity and real worth of a number of these papers is attested by the circumstance that several were published. The honest increase in self-respect and self-confidence which came to the student who saw his composition in print was alone worth to him the time spent upon the course, and the simple exhibit of printed articles "written by members of earlier classes" did much to stimulate younger brothers. In reading the papers I played variously the rôles of gentleman farmer, interested capitalist, prospective buyer, city councilman, and general reader of a popular science magazine. Although the papers were the most difficult to correct of any which fell to my lot during the year, I do not remember that I was bored by very many of them; on the contrary, most of them proved very entertaining.

Next to the long themes, the individual conferences were perhaps the most productive part of the course; this, at least, was the testimony of many students. As has been said, these conferences were essentially private lessons of from fifteen minutes to half an hour in duration. They were an integral part of the work; students were required to attend regularly and were marked absent for non-attendance. The plan of regular, individual conferences added to the instructor's teaching program from five to six hours of intense work each week; but the results amply justified the extra labor. The conference was a business meeting, and not much time was given over to talk about the weather or the latest baseball game. The theme of the preceding week formed the center of the discussion. It had been corrected and returned to the student, and he had examined it before coming to the office. There we went at it hammer and tongs and analyzed it from beginning to end with especial emphasis upon those faults to which the student seemed peculiarly liable. I always took great pains to commend the student for his good work as well as to point out his errors. Perpetual fault-finding even in themes of the poorest student defeats its own end; it discourages the student who is in peculiar need of encouragement and often removes incentive to further effort. It is usually much more productive of good results to say pleasantly, "Now this is very good at this point; let me see if you can't do it again," than to explode in black damnation of a piece of work which may have cost the student hours of labor. Unless there was overwhelming evidence to the contrary, I always assumed that, as a matter of course, the student's work represented on his part a serious effort of considerable duration, and I was always careful to meet him half way by praising wherever I could conscientiously do so. Following the theory, furthermore, that a student's real gain comes from his discovery of his own errors, I never pointed out a defect directly where I could lead the student to discover it for himself. In composition teaching one of the most difficult problems is that of making the student genuinely

self-critical. Usually he makes little or no effort to revise his compositions thoroughly until they come back from the instructor splashed with red ink. But in self-criticism alone lies self-confidence in writing, and independence of instructor, and textbook, and course in composition.

A great deal of whatever measure of success the Wisconsin course has enjoyed came, as might have been expected, from the encouragement and active support given the course by members of the engineering college faculty, and especially from the circumstance that the students were for the most part earnest and high-minded. In fact, I do not believe that there is any better type of student in America than the junior and senior engineers. Disciplined by the drill of the early years of their college course and already beginning to have a vision of the responsibilities which lie even at the threshold of the great profession of which they will soon be members, they face present duties with an earnestness and cheerfulness which stimulates any instructor who is not case-hardened. And such students it is a pleasure and not a duty to instruct.

TREASURER'S REPORT.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

JUNE 21, 1917.

TRADING ACCOUNT.

6/16/16 Inventory	$3,203.10	
Cost of Publications*	4,254.80	
Less Inventory of 6/21/17	3,193.55	
Cost of Sales		$4,264.35
		$4,264.35
Sales of Publications to members and non-members.	$534.91	
1/4 of members dues	1,443.50	
3/10 of institutional dues	177.75	$2,156.16
Advertising	$1,047.50	
Less discount	16.40	1,031.10
		$3,187.26
Balance-Profit and Loss account. *Loss*		1,077.09
		$4,264.35

PROFIT AND LOSS ACCOUNT.

Annual Meeting 1916	$193.79	
Balance-Trading Account		$1,077.09
Committee Expenses	133.75	
Treasurer's Honorarium	303.79	
Secretary's Honorarium	1,000.00	
Assistant Secretary's Honorarium	600.00	
Secretary's Clerical Assistant†	795.10	
Postage and Expresses	392.75	
Telephone and Telegraph	24.63	
Office Supplies	133.91	
Annual Meeting 1917	87.69	3,665.41
		$4,742.50
Balance-Profit for year		16.18
		$4,758.68
		$4,758.68
Dues—Individual (3/4)	$4,330.50	
Dues—Institutional (7/10)	414.75	
Exchange	.56	
Interest on deposit	12.87	$4,758.68
		$4,758.68

* Does not include cost of *Bulletin* for June.
† Does not include June expenses.

TREASURER'S REPORT.

BALANCE SHEET.

ASSETS.

Accounts Receivable:		
Individual		
Current Dues, B.B.	$2,140.00	
Back Dues, A.A.	1,787.22	
Institutional		
Current Dues		
E.E.	200.00	
Back Dues		
Non-members (C.C.)	233.09	
At Dr. Bishop's Office	88.22	$4,448.53
Cash:		
Lincoln Trust Co.	$669.16	
Life Membership Fund	397.20	
Dr. Bishop's Office	150.00	$1,216.36
Inventory		3,193.55
		$8,858

LIABILITIES AND SURPLUS.

Accounts Payable G. G.	$3,279.50
Members paid in advance (D.D.)	58.60
Due Non-members F. F.	3.60
Life membership	397.20
Surplus	5,119.54
	$8,858

COMPARATIVE BALANCE SHEET, S. P. E. E.

1915–16

COMPARATIVE BALANCE SHEET.

	1915-6.	1916-7.	Increase.	Decrease.
Accounts receivable:				
Back Dues	$1,216.26	$1,787.22	$570.96	
Current Dues	1,558.26	2,140.00	581.74	
Other Items (Members)	26.14			$26.14
Institutional Dues	105.00	200.00	95.00	
Non-members	377.73	233.09		144.64
At Pittsburgh	23.68	88.22	64.54	
Cash:				
Life Membership Fund	397.20	397.20		191.51
Lincoln Trust Co.	860.67	669.16		
Secretary's Office	150.00	150.00		
Inventory	3,203.10	3,193.55		9.55
	$7,918.04	$8,858.44	$1,312.24	$371.84
			371.84	
			940.40	

TREASURER'S REPORT.

1916–17.

	1915–6.	1916–7.	Increase.	Decrease.
Accounts Payable	$2,159.23	$3,279.50	$1,120.27	$29.50
Due Members	88.10	58.60		1.10
Due New Members	4.70	3.60		149.27
Surplus	5,268.81	5,119.54		
Life Membership	397.20	397.20		
	$7,918.04	$8,858.44	$1,120.27	$179.87
			179.87	
			$940.40	

June, 1916. a/c Payable does not include cost of *Bulletin* for March, April, May and June.

June, 1917. a/c Payable does not include cost of *Bulletin* for June.

EDITORIAL.

Engineering Societies and Education.—Dean Benton calls attention in the September number of ENGINEERING EDUCATION to the almost universal rule of engineering societies which make graduation from an engineering college equivalent to two years of practical work.

This requirement arises from the fact that there are two aspects of the engineering profession, one the art or trade of engineering, and the other, the true profession of engineering. It is much easier to define the first than it is the second. It is the profession of engineering which is, and should be taught in engineering schools. The art or trade of engineering should be learned from practical experience both before and after graduation.

Graduation from a recognized engineering school is now the most distinguishing single and common attribute of all engineers. Why not then go a step further than Dean Benton suggests and *make graduation the fundamental requirement of admission to real professional engineering societies and in lieu of this the candidate should present not less than ten years of practical experience?*

HAVE YOU PAID YOUR DUES? IF NOT DO IT NOW. MAKE OUT YOUR CHECK PAYABLE TO W. O. WILEY, TREASURER, 432 FOURTH AVENUE, NEW YORK CITY, FOR CURRENT AND BACK DUES AND THUS AVOID THE NECESSITY OF SENDING OUT A THIRD BILL.

COLLEGE NOTES.

Iowa State College.—*S. W. Beyer,* Professor of Geology and Mining Engineering and Vice Dean, assumes the duties of Dean of Engineering, left vacant when Dean Marston received a commission as Major in the Iowa National Guard. Major Marston is now located at Camp Cody, near Deming, New Mexico. *C. S. Nichols,* Assistant to the Dean, will carry on the work along sanitary engineering lines formerly assumed by Professor M. I. Evinger, who is at the present time doing commercial work. *T. R. Agg,* Professor of Highway Engineering, assumes the duties of Captain in the Officers' Reserve Engineering Corps. *J. S. Dodds,* formerly with the Iowa Highway Commission, fills Professor Agg's place in the college. *B. F. Hastings,* of Bridgeport, Conn., occupies the place formerly held by B. S. Myers, who is now with the Kansas City Structural Steel Company. *R. A. Pochel,* of Minot, N. Dak., formerly assistant City Engineer of that city, takes the place of B. F. Hopkins. *B. Kamrass* becomes laboratory assistant in the Highway Department of the Engineering Experiment Station. *J. F. H. Douglass,* Assistant Professor of Physics, has accepted a position with the Texas Agricultural College. *Wm. Nyswanger,* of the same department, has been granted a leave of absence on account of his health. *J. C. Pomeroy,* instructor in Physics, has resigned to accept a position in the Physics Department of "The Citadel," Charleston, South Carolina. *Harl Boileau,* instructor in Mechanical Engineering, is now with the Allied Machinery Company, of New York City. *Harry Gruwell,* one of the special men in the Mechanical Department, is now superintendent of the machine shops at Highland Park College, Des Moines. *F. B. Sisler* is instructor in telegraphic code practice, for Signal Service preparation, a new position created on account of the co-operative work the college is undertaking, to aid the United States Signal Corps. *G. H. Montillon,* former graduate student in Chemical Engineering, received the appointment of teaching fellow. *John E. Smith,* formerly

of the University of North Carolina, was appointed to the position of Assistant Professor in Geology.

Massachusetts Institute of Technology.—The faculty changes have introduced some new problems since there has been so much demand by the U. S. Government and by industrial corporations related to the war for men of technical skill. On the other hand the demands for instruction have not only not decreased, for the registration is but slightly less than normal with much the same distribution through courses, but are to a considerable extent greater for the Institute is furnishing instruction in academic and engineering lines to the important schools of aeronautics for the army and the navy, and is carrying on no less than three schools for deck officers and the school for marine engineers.

Some of the changes are the retirement of Professor Charles R. Cross, with the title, Professor Emeritus, and the appointment of Professor E. B. Wilson of the department of Mathematics to the chair of Mathematical Physics and head of the department of Physics. Professor C. L. Norton has been appointed professor of Industrial Physics, an option which is assuming more and more importance, and Dr. Charles R. Mann has been appointed professor of Education and Educational Research.

Purdue University.—In the School of Electrical Engineering, the following changes have occurred in the personnel of the department staff:

Professor L. D. Rowell has been commissioned a Captain in the Engineer Officers' Reserve Corps and is now in active duty as the Recorder of the Board of Engineer Troops, Washington, D. C.

Messrs. J. B. Sheadel and H. E. Phelps, Instructors in Electrical Engineering, have resigned, the former entering the Service of the Union Traction Company of Indiana, and the latter that of the American Telephone & Telegraph Company of New York.

Most of the members of the departmental faculty spent

the summer vacation in engineering work of some kind or other. Professor C. Francis Harding was with the engineering department of the Commonwealth Edison Company. Professor Alfred Still was engaged with a revision of his text book on "Overhead Electrical Transmission Lines." Professor D. D. Ewing, as a special representative of the editorial staff of the Electric Railway Journal, visited a number of electric railway properties. Professor R. V. Achatz was engaged in a study of telephone transmission conditions on the lines of the Michigan Telephone Company.

The effect of the war upon the enrollment in the Schools of Engineering is indicated by the following statistics:

School.	Year.	Number of Students.			
		Freshmen.	Sophomore.	Junior.	Senior.
Electrical	1916	117	87	64	49
	1917	99	57	40	37
Mechanical	1916	121	92	74	59
	1917	81	67	54	37
Civil	1916	77	44	44	45
	1917	66	46	20	22
Chemical	1916	84	51	38	25
	1917	91	44	30	21

Stevens Institute of Technology.—Prof. Albert F. Ganz, head of the department of electrical engineering, passed away on July 27. L. A. Hazeltine, formerly assistant professor, has been appointed acting head of the department. The following instructors have been promoted assistant professors: F. C. Stockwell, electrical engineering; G. G. Freygang, mechanics; L. A. Belding, mechanical engineering; L. H. Backer, chemistry. The following instructors have been newly appointed: H. Fezandié, mechanical engineering; G. M. Weimar, English and logic; C. H. Bertolf, descriptive geometry and mechanical drawing. Instructor E. Byron has been transferred from descriptive geometry and mechanical drawing to physics. C. E. Hedden, formerly instructor in mechanism and machine design, has accepted an assistant professorship in vocational education at the Carnegie Institute of Technology.

BOOK REVIEWS.

The Design of Railway Location. By CLEMENT C. WILLIAMS, Professor of Railway Engineering, University of Kansas. First edition. New York, John Wiley & Sons, Inc. Cloth 6×9. 517 pages. $3.50.

The purpose of the author clearly sets forth the fundamental principles underlying railway location for the assistance of teachers and students of technical schools rather than providing a reference book on the subject. It is intended primarily as a text but there is much material contained in the work which will be of value to those engineers engaged in practical railroad work.

The volume considers location chiefly from the standpoint of regrouping and relocation now becoming necessary on account of the difference in traffic and operating conditions from those obtaining when the roads were built. Beginning with a brief historical review of railway development in America, railway organization, Government control of railways, valuation, effect of volume of traffic, operating expenses, and rate making are taken up. Steam and electric locomotives are classified and compared and the results of tests shown. The practical engineer will find useful the chapter on momentum grades and the effect of rise and fall upon operating costs. He will consider the volume rather elementary in parts but from the standpoint of the student this is desirable. The work gathers together in one volume of convenient size practically all the fundamentals concerning the important branches of railroading.

L. W. McI.

Principles of Electrical Design.—Direct and Alternating Current Generators. By ALFRED STILL, Professor of Electrical Design, Purdue University. Author of Overhead Electric Power Transmission, and Polyphase Motors. McGraw-Hill Book Co. 1917. 6×9. 365 pages, 146 illustrations. Cloth. $3.00 net.

A text book on design written primarily for the electrical engineering student, and not intended as a reference book for the finished designer. Exceptional stress is laid on visualizing the work in hand. While fundamental principles and theories are definitely adhered to, they are presented in such a manner as keep the physical "action" ever before the student. Illustrative design sheets are worked out for specific designs.

H. E. D.